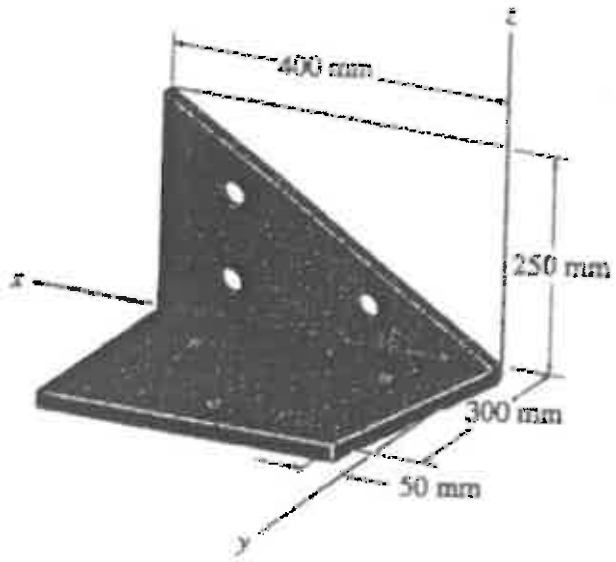
PROGRAM	:	NATIONAL DIPLOMA EXTRACTION METALLURGY
SUBJECT	:	**PROCESS ENGINEERING 2**
CODE	:	**MPE 21- 1**
DATE	:	WINTER SSA EXAMINATION 2015 14 JULY 2015
DURATION	:	(SESSION 1) 08:00 - 11:00
WEIGHT	:	40 : 60
TOTAL MARKS	:	100

ASSESSOR	:	MISS M MADIBA
MODERATOR	:	DR C CHITEME 5119
NUMBER OF PAGES	:	3 PAGES AND 2 ANNEXURES

INSTRUCTIONS	:	ANSWER ALL QUESTIONS.
REQUIREMENTS	:	2 SHEETS OF GRAPH PAPER PER STUDENT

QUESTION 1

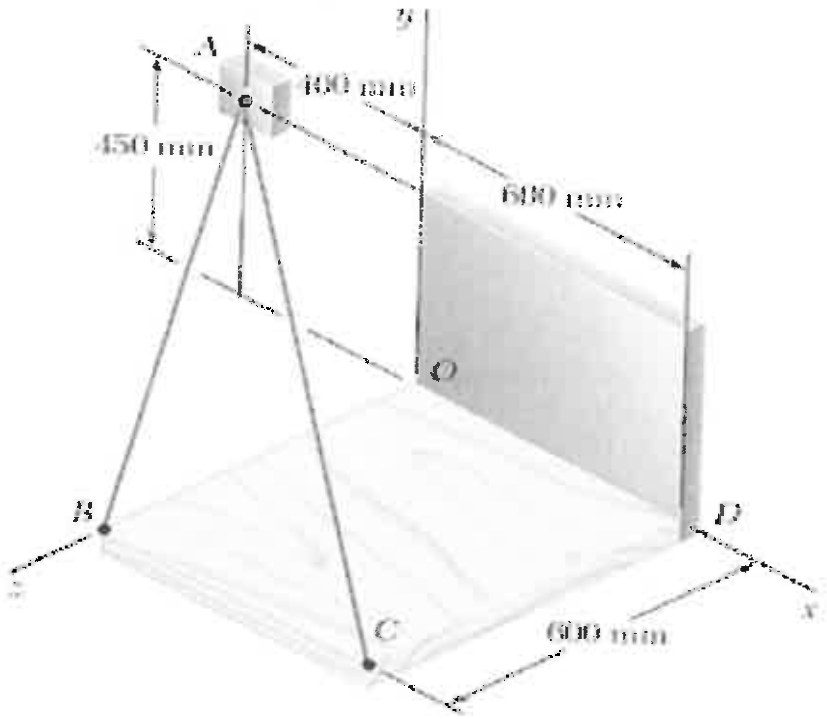
1.1 Determine the angle between the edges of the sheet-metal bracket.



(10)

1.2 What will be the distance from P (2,-1, 7) to point Q (1,-3,5)? (3)

1.3 Knowing that the tension is 850 N in cable AB and 1020 N in cable AC, determine the magnitude and direction of the resultant of the forces exerted at A by the two cables.

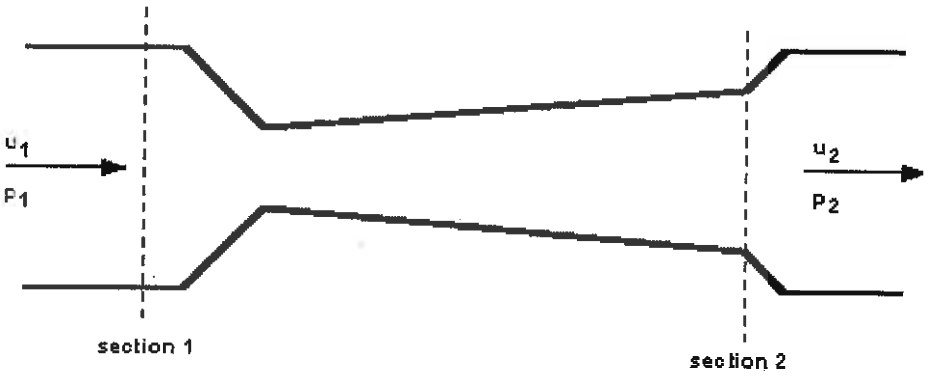


(17)

[30]

QUESTION 2

2.1



A fluid, density ρ = 960 kg/m^3 is flowing steadily through the above tube. The section diameters are d_1=100mm and d_2=80mm.The gauge pressure at 1 is p_1=200kN/m^2. The velocity at 1 is u_1=5m/s. The tube is horizontal (z_1=z_2).
What is the gauge pressure at section 2? (10)

2.2 What height would a water barometer need to be to measure atmospheric pressure?

(5)

[15]

QUESTION 3

3.1 A centrifugal pump delivers water at the rate of 1800 litres per minute, to a height of 20m through a 0.1m, diameter, 80m long pipe. Find the power required to drive the pump, if the overall efficiency is 65%, and Darcy's friction factor=0.02. (10)

3.3 A centrifugal pump is required to produce a flow of water at a rate of 0.0160 m^3/s against a total head of 30.5 m. The operating characteristic of a pump at a speed of 1430 rev/min and a rotor diameter of 125 mm is as follows.

Efficiency	0	48	66	66	45	%
Q_A	0	0.0148	0.0295	0.0441	0.059	m^3/s
H_A	68.6	72	68.6	53.4	22.8	m

Determine the correct size of the pump and its speed to produce the required head and flow. (20)

[30]

QUESTION 4

4.1 Discuss the importance of project planning and cost estimating with respect to plant maintenance. (10)

4.2 Explain the different types of Hydrogen damages in pipes. (15)

[25]

TOTAL **[100]**

6/…

FORMULA SHEET

$$\tau = \mu \frac{du}{dy}$$ $$\nu = \frac{\mu}{\rho}$$ $$p = \rho g h$$

$$R = \rho g \bar{x} A$$ F = pressure at centroid × area $$S_c = \frac{I_{xx}}{A\bar{x}}$$

$$I_{xx} = I_{GG} + A\bar{x}^2$$ $$Q = Au = A_1u_1 = A_2u_2$$ $$\frac{p_1}{\rho g} + \frac{u_1^2}{2g} + z_1 = \frac{p_2}{\rho g} + \frac{u_2^2}{2g} + z_2 + h_f$$

$$u = \sqrt{2g(h_2 - h_1)}$$ $$u_1 = \sqrt{\frac{2gh(\rho_m - \rho)}{\rho}}$$ $$h_f = \frac{32\mu L u}{\rho g d^2}$$

$$Q_{actual} = C_d A_1 A_2 \sqrt{\frac{2gh\left(\frac{\rho_{man}}{\rho} - 1\right)}{A_1^2 - A_2^2}}$$ $$Q = C_d A_o \sqrt{2gh}$$ $$Q_{theoretical} = \sqrt{2g}\int_0^H b h^{1/2}\, dh$$

$$Q_{actual} = C_d A_1 A_2 \sqrt{\frac{2g\left(\frac{p_1 - p_2}{\rho g} + z_1 - z_2\right)}{A_1^2 - A_2^2}}$$ $$Q = C_d \frac{2}{3} B \sqrt{2g}\, H^{3/2}$$ $$Q = C_d \frac{8}{15}\sqrt{2g}\tan\left(\frac{\theta}{2}\right) H^{5/2}$$

$$F_T = F_R + F_B + F_P$$ $$Re = \frac{\rho u d}{\mu}$$ $$Q = \frac{\Delta p}{L}\frac{\pi d^4}{128\mu}$$

$$F = Q\rho(u_2 - u_1)$$

$$h_f = \frac{32\mu L d}{\rho g}$$

APPENDICES

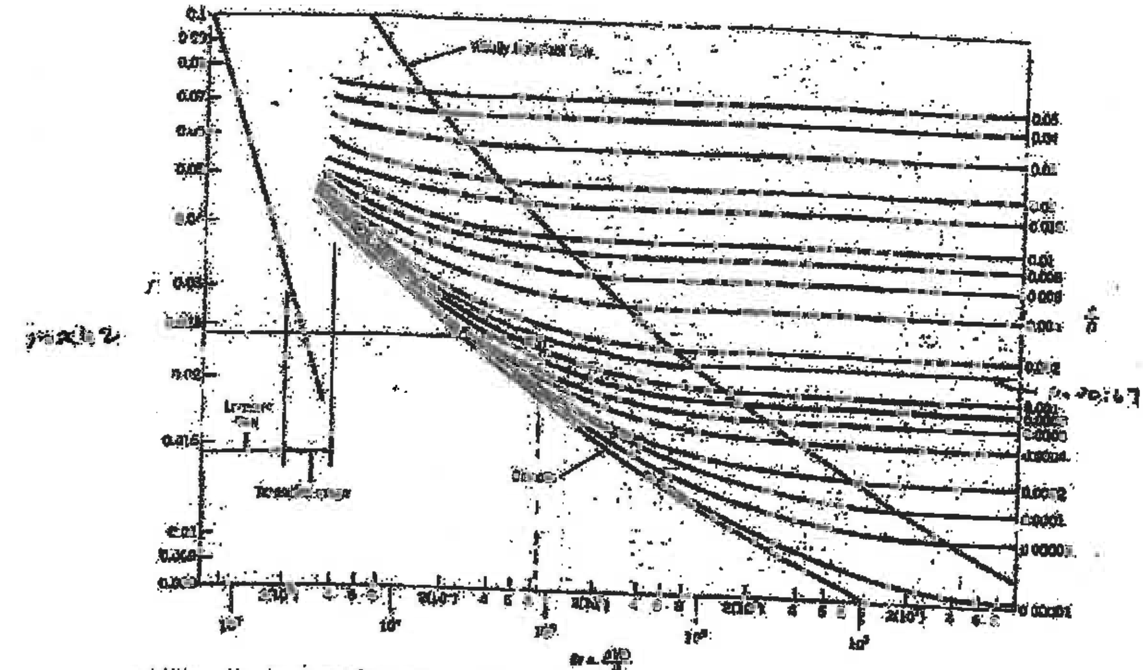


FIGURE 5.26 [illegible] for [illegible] pipes—the Moody chart. [illegible] from Ref. 7 [illegible]

Pipe Flow

Darcy-Weisbach formula $h_f = \frac{\Delta P}{\rho g} = \frac{flQ^2}{3d^5}$

Rough pipe formula $\frac{1}{\sqrt{f}} = 4.0 \log_{10}\left(\frac{R}{k_s}\right) + 3.48$

Colebrook-White formula $\frac{1}{\sqrt{f}} = -4.0 \log_{10}\left(\frac{2.51}{2R\sqrt{f}} + \frac{k_s}{3.7d}\right)$

Pumps

Work done per unit weight of fluid $= \frac{1}{g}(V_{w2}u_2 - V_{w1}u_1)$

Hydraulic efficiency $\eta_h = \frac{gH}{V_{w2}u_2}$

Specific speed $N_s = \frac{N\sqrt{Q}}{H^{3/4}}$

Open channel hydraulics

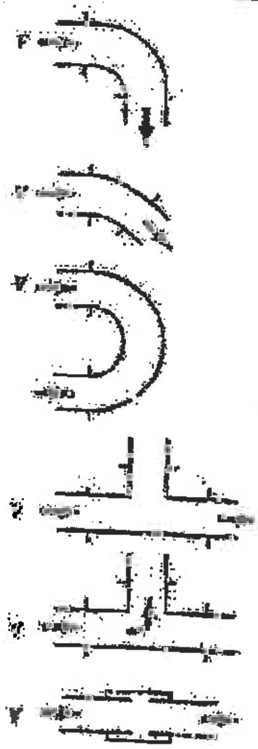
Chezy formula $Q = AC\sqrt{mi}$

Manning's formula $C = \frac{1}{n}m^{1/6}$

TABLE 8.2

Loss Coefficients for Pipe Components $\left(h_L = K_L \frac{V^2}{2g}\right)$ (Data from Refs. 5, 10, 27)

Component	K_L
a. Elbows	
Regular 90°, flanged	0.3
Regular 90°, threaded	1.5
Long radius 90°, flanged	0.2
Long radius 90°, threaded	0.7
Long radius 45°, flanged	0.2
Regular 45°, threaded	0.4
b. 180° return bends	
180° return bend, flanged	0.2
180° return bend, threaded	1.5
c. Tees	
Line flow, flanged	0.2
Line flow, threaded	0.9
Branch flow, flanged	1.0
Branch flow, threaded	2.0
d. Union, threaded	0.08
e. Valves[a]	
Globe, fully open	10
Angle, fully open	2
Gate, fully open	0.15
Gate, $\frac{1}{4}$ closed	0.26
Gate, $\frac{1}{2}$ closed	2.1
Gate, $\frac{3}{4}$ closed	17
Swing check, forward flow	2
Swing check, backward flow	∞
Ball valve, fully open	0.05
Ball valve, $\frac{1}{3}$ closed	5.5
Ball valve, $\frac{2}{3}$ closed	210



[a] See Fig. 8.36 for type of valve geometry.